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High Performance Commercial Building Systems

Data Logging Guide for Siemens Energy Management and Control Systems

Element 5 - Integrated Commissioning and Diagnostics
Project 2.2 - Monitoring and Commissioning of Existing Buildings
Task 2.3.1 - Develop a guide to implementation of monitoring systems in existing buildings

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California Energy Commission

Data Logging Guide

for

Siemens – EMCS

Energy Management and Control Systems

Submitted by

Energy Systems Laboratory

Texas A&M University

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Numerous individuals contributed to completing the Guide. Siemens assigned key engineers to this effort. Yasuko Sakurai from the Energy Systems Laboratory was the lead engineer on this effort. She spent several months researching engineering details to make this usable. Lindsey Turns and Lindsay Patton also spent considerable time in reviewing and editing this work. The project lead was Charles Culp, P.E., Ph.D., Associate Director of the Energy Systems Laboratory and Visiting Professor at Texas A&M University.

Siemens did not perform a final review on this document and has declined to endorse the information contained in this Guide. Siemens stated that they plan to use a wider range of equipment to accomplish these monitoring functions. The objective of this Guide was to focus on the manufacturer's existing EMCS hardware and software, since this would be definitely supported by the manufacturer. Additional monitoring devices can be added to EMCS systems, and users are urged to contract their Siemens representatives for equipment, which is directly supported by Siemens to upgrade their systems to perform data logging capabilities. Nonetheless, the authors wish to thank Siemens for the time their engineers did spend in assisting with the compiling of the data. We believe that the information contained in this Guide is correct and will be of benefit to users who want to upgrade their systems using Siemens equipment.

Table of Contents

EXECUTIVE SUMMARY

This Guide presents detailed procedures to determine the monitoring capability of an existing EMCS (Energy Management Control System) and perform any upgrades to the EMCS to enable data logging. This Guide outlines procedures to enable an existing EMCS to measure the hourly energy consumption of a building or facility. The parameters to monitor include electrical consumption, thermal consumption (flow and temperatures), room temperature and other physical parameters.

This Guide enables the user to understand and verify how the existing controller can be configured to monitor the above parameters. Briefly, this includes:

- Determining the functionality of the existing EMCS controller models and software versions.
- Upgrading the physical monitoring capability of the existing controller, if needed.
- Selecting the correct sensors for the application in existing EMCS controllers.
- Following procedures to set-up and configure the EMCS to log the desired data.

Once these procedures are fully implemented, the existing EMCS can be effectively used as a data logger. This results in a very cost effective method to acquire data logger quality data in an existing EMCS.

CHAPTER 1. INTRODUCTION

This Guide covers products designed by Siemens and introduced since 1994. A complete list of Siemens' software and hardware products that have been installed since 1994 are detailed in this Guide. Improvements to the products are also covered. This Guide presents detailed procedures to determine the monitoring capability of an existing Siemens EMCS (Energy Management Control System) and perform any needed upgrades to the EMCS to enable data logging.

Chapter 2 covers how to determine the functionality of the existing EMCS controller and software versions. Also covered is how to determine if upgrades are needed to the existing system. After implementing the steps in Chapter 2, the base system will be ready to be configured and used as a data logger.

Chapter 3 then covers specifically how to set-up and configure the EMCS as a data logger. Procedures are provided to enable selected data logger monitoring functions. These include electrical consumption, thermal flow and room monitoring. Data collection and storage requirements are also provided.

The Appendices covers programming details and accuracy determinations. A specific electrical consumption accumulation program, a thermal consumption calculation program and an extended log archiving program are provided. An example of temperature accuracy is provided so that the user can better determine the accuracy of thermal measurements.

This Guide enables the user to understand and verify that the existing controller can be configured to monitor the above parameters. Briefly, this includes:

- Determining the existing EMCS controller models and software versions.
    - Table 1 in Chapter 2 lists Siemens' controllers and software versions. If the existing controller models and software versions found in the facility are listed in Table 1, this Guide can be used to upgrade the EMCS to store historical data of the parameters needed to determine the hourly energy consumption in a facility.

- Upgrading the physical monitoring capability of the existing controller, if needed.
  - Chapter 2 contains guidance on what will need to be upgraded based on the existing EMCS models and software.
- Selecting the correct sensors for the application in existing EMCS controllers.
  - Chapter 3 provides information about what input types different controllers can accept and provides accuracy of the sensors. Guidance in selecting the correct sensor type is provided.
- Following procedures to set-up and configure the EMCS to log the desired data.
  - Chapter 3 provides procedures to configure the EMCS to log data for specific applications. The applications include electrical consumption and demand monitoring using a Watt-Hour transducer, electrical consumption and demand monitoring using a Watt transducer, thermal monitoring using a BTU meter or EMCS, monitoring room temperature and data collection and storage guidance.

CHAPTER 2. DETERMINE EXISTING SYSTEM FUNCTIONALITY

Step 1: Check the software version and the existing controller model of the controller connected to the sensor that will be used.

Step 2: Verify the firmware release and hardware/software compatibility.

Step 3: Find the general specification of the controller and the input type for each controller.

Step 4: Check data logging performance of controller.

Step 5: Upgrade EMCS for data logging

Details of each step follow.

Step 1: Check the software version and the existing controller model of the controller connected to the sensor that will be used

If the controller model is listed in Table 1, this manual can provide a guideline to set-up and store the history data. If the existing controller model is not included, consult with Siemens for the possibility of using the existing controller or upgrading it to a current model.

Table 1. Siemens Products of Interest

Hardware
MBC (Modular Building Controller)
RBC (Remote Building Controller)
MEC (Modular Equipment Controller)
SCU (Stand-alone Control Unit)
UC (Unitary Controller)
RCU PII (Remote Control Unit)
Software
Insight
InfoCenter Suite

Table 2 provides a time frame of each product listed in Table 1. The first six rows of the time row are hardware time frames and the latter two rows are the software time frame. In each row, the double lines at the beginning and the end of the year represent the starting time and the ending time of the product.

Table 2. Siemens Product History

	1994	1995	1996	1997	1998	1999	2000	2001
MBC	■	■	■	■	■	■	■	■
RBC	■	■	■	■	■	■	■	■
MEC				▌■	■	■	■	■
SCU	■	■	■	■	■	■	■■	
UC	■	■	■	■	■	■	■	■▐
RCU PII	■	■	■▐					
Insight	■	■	■	■	■	■	■	■
InfoCenter Suite					▌■	■	■	■

■ Represents Insight and its compatible system

▌■ Represents the starting year of system which is compatible to Insight

■▐ Represents the ending year of system which is compatible to Insight

Details of controller listed in Table 1 are:

- Modular Building Controller (MBC): This controller is a modular, programmable primary controller with 24 I/O or 40 I/O module capacity enclosure and supervisory interface capability to monitor a secondary controller network. It is designed to control general HVAC applications, data acquisition and other multi-equipment applications.

- Remote Building Controller (RBC): This controller provides the same functional capabilities as the MBC with I/O count and more communications and security options to allow for remote communications. It is available in 12 module capacity enclosure.
- Modular Equipment Controller (MEC): The MEC is a modular, programmable primary control unit that does not support a secondary network. It provides 32 fixed on-board I/O, with some units having expansion capability.
- Standalone Control Unit (SCU): Tthe SCU is a programmable primary controller with supervisory interface capability to monitor a secondary network. It is required to upgrade the SCU to version 5.0 Controller Board to be able to run Apogee on the SCU. Consult with a Siemens Representative for more information.
- Unitary Controller (UC): The UC is a programmable, standalone controller with seven inputs and five outputs (expandable to 14 inputs and 10 outputs). The UC resides on the secondary floor level (P1) polling network. It is designed to perform control, monitoring and energy management functions for general HVAC applications.
- RCU PII: This unit must be upgraded by using existing wiring and installing a MBC Backplane in its place. Consult with a Siemens Representative for more information.

System 600 has two versions of revision with Insight Software, Pre-Apogee and Apogee firmware. Insight is a software program created by Siemens Building Technologies. It controls and monitors HVAC, lighting and other environmental systems. This software also allows the operator to collect operating or environmental data, generate reports, and includes a graphic package that provides an animated color display. For monitoring purposes, Insight accompanied by InfoCenter Suite, provides a means of collecting data from controllers and managing, retrieving and archiving historical data from the Insight. The procedure to set-up data collection and storage will be shown later in this manual (see Chapter 3, Application F). Insight can be run on different O/S depending on the Insight revision. Insight 1.X runs on Windows 3.12. Insight 2.X runs on Windows 95/98 and communicates with field panels that have firmware revision 1.X and 12.X. Insight 3.X runs on Windows NT and Windows 2000 and communicates with field panels that use firmware revision 2.1 and later (Apogee firmware) as well as field panels with pre-Apogee firmware. Most features, especially data collection, still work the same way. For more information, contact a Siemens representative.

Step 2: Verify the firmware release and hardware/software compatibility

The current software, Insight 3.X, is compatible with field panels that use firmware revision 2.1 and later (called Apogee firmware) and field panels with revision 1.X and 12.X (called Pre-Apogee firmware). Since Pre-Apogee firmware is not Y2K compliant, upgrading the firmware revision to Apogee firmware is recommended. Contact a Siemens representative for more information.

The field panel firmware revision can be found by running "Panel Configuration Report" on Insight software. In Insight, perform the following steps:

a. Select "Report Builder", and then within "Definition" select "New".
b. From the report list, select "Panel Configuration Report" and the Panel Configuration editor will be displayed.
c. Under Field Panel section, click "Add" and the object selector will be displayed.
d. Select the field panel of interest from the list and then click "OK".
e. In Panel Configuration editor under Output click "Configure" select "Screen" and then click "OK"
f. Click the "Run Report" button and the report window will display details of the panel.

Hardware and firmware revisions can be found in this report.

Step 3: Use Table 3 to find the general specification of the controller and the input type for each controller

The four input types included for analog inputs are current, voltage, thermistor and platinum RTD. The digital input type requires the input to have a counter or accumulative feature. For example, if MBC is going to be used for the purpose of monitoring room temperature, from Table 3 shows that either current, voltage, thermistor or platinum RTD type temperature sensors can be used with this controller with the appropriate type of PTM (Point Termination Module). The appropriate sensor to use depends on the purpose of the monitoring, the required accuracy of the application and the cost of the temperature sensor. Table 3 includes the accuracy at the panel of each input type. The end-to-end accuracy can be calculated from the accuracy of the temperature sensor and the accuracy of panel reading. This will help select the correct sensor.

Table 3. Siemens Hardware Specification

Model	Analog Input				Digital Input	
	Current	Voltage	Thermistor	Platinum RTD	Digital	Counter
MBC, RBC PTM6.2P1K	N/A	N/A	N/A	1000 Ω Accuracy: N/A*	N/A	
PTM6.2N100K	N/A	N/A	100 K Accuracy: N/A*	N/A	N/A	
PTM6.2I420	4-20 mA Accuracy: N/A*	N/A	N/A	N/A	N/A	
PTM6.2U10	N/A	0-10 VDC Accuracy: N/A*	N/A	N/A	N/A	
PTM6.2C	N/A	N/A	N/A	N/A	N/A	Dry contact Freq.: 25 Hz (max) Pulse Width: 20ms (min)

* There is no general information about accuracy provided from Siemens. Contact a Siemens representative with specific sensor type for case-by-case information.

Table 3.(cont.) Siemens Hardware Specification (continued)

	Analog Input				Digital Input	
	Current	**Voltage**	**Thermistor**	**Platinum RTD**	**Digital**	**Counter**
MEC	4-20 mA Accuracy: N/A*	0-10 VDC Accuracy: N/A*	N/A	1000 W/Ω Accuracy: N/A*	Dry Contact / 250 VAC max Freq.: 25 Hz (max) Pulse Width: 20 ms (min)	
SCU	4-20 mA Accuracy: N/A*	0-10 VDC Accuracy: N/A*	100 K Accuracy: N/A*	N/A	Dry Contact / 250 VAC max Freq.: 25 Hz (max) Pulse Width: 20 ms (min)	
UC	0-20 mA Accuracy: 0.5% [0.05% typical]	0-10 VDC Accuracy: 0.5% [0.09% typical]	N/A	-40 to 350°F Accuracy: 1.8°F [0.5°F typical]	Dry Contact Freq.: 10 Hz (max) Pulse Width: N/A** ms (min)	

* There is no general information about accuracy provided from Siemen. Contact a Siemens representative with specific sensor type for case-by-case information.

** The minimum pulse width is not provided but speculated to be at least 50 ms. Contact a Siemens representative for more details.

Step 4: Check data logging performance of controller

Knowing the existing controller, use Table 4 to check the acceptable data logging performance of the controller for each monitoring parameter: electrical consumption, thermal consumption and room temperature. Table 4 provides recommendations in the event the existing controller cannot be used to monitor a parameter.

Table 4. Siemens Hardware and Monitoring Capabilities Compatibility

	Electrical Consumption		**Thermal Consumption**		**Room Temperature**
Sensor Device Output	Digital	Analog	Digital	Analog	Analog
MBC	•	•	•	•	•
RBC	•	•	•	•	•
MEC	•	•	•	•	•
SCU	X[1]	X[1]	X[1]	X[1]	X[1]
UC	•	•	•	X[2]	•
RCU PII	X[3]	X[3]	X[3]	X[3]	X[3]

- Indicates acceptable performance for logging a point type

X[1] SCU must be upgraded to SCU Version 5 Controller

X[2] UC can be used for thermal consumption calculation with current or voltage input type only

X[3] RCU PII must be upgraded by using existing wiring and installing a MBC backplane.

Step 5: Upgrade EMCS for data logging

The suitability of the existing EMCS equipment should now be determined so that any needed upgrades can be accomplished. For example, if a remote panel needs to be upgraded to improve the accuracy, this should be done before continuing with the set-up procedures in Chapter 3.

After establishing the compatibility and type of parameter to be monitored and logged and after knowing which type of meter or calculation to be used, the set-up procedures can be selected.

The following application set-up procedures are outlined in Chapter 3 for specific functions:

- Electrical Consumption and Demand Monitoring Using Watt Hour Transducer (digital input)
- Electrical Consumption and Demand Monitoring Using Watt Transducer (analog input)
- Thermal Consumption Monitoring Using BTU Meter
- Thermal Consumption Monitoring Using EMCS
- Room Temperature Monitoring

CHAPTER 3. APPLICATION SET-UP PROCEDURES

The following procedures and charts provide the requirements to enable the existing controllers to perform the specified functions. These procedures are covered in detail in Chapter 3.

Application A. Electrical Consumption and Demand Monitoring Using A Watt-Hour Transducer.
Application B. Electrical Consumption Monitoring Using A Watt Transducer.
Application C. Thermal Consumption Monitoring Using a BTU Meter.
Application D. Thermal Consumption Monitoring Using an EMCS.
Application E. Room Temperature Monitoring.
Application F. Data Collection Configuration and Storage in Insight and Data Collection and Archiving in Infocenter.

Application A. Electrical Consumption and Demand Monitoring Using a Watt Hour Transducer

Application A provides the user with steps to follow in setting up a Watt Hour Transducer to monitor electrical consumption and demand. By following these steps, the user will enable the EMCS to measure electrical consumption (kWh) and store fifteen-minute data. Chart A-1 lists the needed equipment and helps the user determine if the controller has an available input slot. Chart A-2 aids the user in choosing a Watt Hour Transducer (WHT) and a Current Transducer (CT). The chart lists the accuracy, pulse widths, and pulse rates for each controller model that the WHT must have. The chart also lists wire and sensor specifications. Tips for CT installation are provided as well. Chart A-3 provides an example of a WHT and a CT available in the market. Chart A-4 provides the EMCS programming steps. By following these steps, the user will enable the EMCS to accumulate daily and monthly consumption and record 15-minute consumption. The user should proceed to Application F to set-up the data collection and history data storage.

Step 1. Check the input slot availability on the controller.

Use Chart A-1 to find which slots are needed on the controller. The position of the slot can be found in Chart A-1 under Controller Terminal Connections. For example, the MBC has two enclosure sizes, 24 module size and 40 module size. If there is a slot available, PTM6.2C will be installed. If there are no available slots, contact a Siemens representative to determine whether an expansion I/O module can be added to this controller or if an additional controller should be installed.

Step 2. Choose a Watt-Hour Transducer (WHT) and Current Transducer (CT).

Chart A-2 lists the WHT and CT specifications. For example, an acceptable Watt-Hour Transducer for the RBC should have digital output with ± 0.5% accuracy or better and at least 20 ms pulse width at 25 Hz maximum pulse rate. With matching CT output and accuracy selection of ± 1% or better, the end-to-end accuracy from the transducers to the

RBC controller could estimate ± 1.5%. Note that to gain this accuracy the transducers must be placed no more than 750 ft. away with 14-22 AWG type wire.

Chart A-3 shows an example of a WHT and a CT provided in the market.

Step 3. Follow the EMCS programming steps.

Chart A-4 provides the steps to set-up the EMCS to accumulate daily consumption, accumulate monthly consumption, and update the values every fifteen minutes. Detailed steps provided in this chart must be followed to set-up the external pulse input points and internal analog output points.

Step 4. Follow the steps in Application F.

Application F lists the steps to set-up the data collection and history data storage.

After following these steps, the system can collect daily and monthly consumption as well as record 15-minute data.

Chart A-1. Electrical Consumption and Demand Monitoring Using a Watt Hour Transducer

Verify that in addition to the sensors and transducer, that the controller has the available slots as discussed below.

	MBC	RBC	MEC	SCU	UC
What is measured	• Electrical consumption data of either One-Phase or Three Phase, 208 to 480 V ac rms., 2400 amps (max), 50/60 Hz				
What is stored in EMCS	• Fifteen-minute data of electrical consumption in kWh units stored in Trend Data History.				
What is needed	3 - CT sensor 1 - Watt Hour Transducer 1 - available slot on Terminal Block (for external discrete input) 1 - available internal analog output point (to accumulate month-to-date consumption)				
Terminal Connections	PTM6.2C	PTM6.2C	DI 5 – DI 8	TB1 DI-24 to DI-29	I/O card1: DI10–DI12 I/O card2: DI30–DI32

Chart A-2. Electrical Consumption and Demand Monitoring Using a Watt Hour Transducer

Watt Hour Transducer and Current Transducer Specifications

	MBC	RBC	MEC	SCU	UC
Output Type from Watt Hour Transducer	Digital (each pulse is equal to xxx kWh, varies with specific sensor)				
Maximum Pulse Rate	25 Hz	25 Hz	25 Hz	25 Hz	10 Hz
Minimum Pulse Width	20 ms	20 ms	20 ms	20 ms	N/A*
Accuracy from Watt Hour Transducer	± 0.5 % (not including CT's)				
Maximum Wire Length (ft.)	750 ft. @ 14-22 AWG				
CT Accuracy	± 1.0 %				
Note	CT sensors Output: Match the input type for Watt Hour Transducer Input: Make sure that input current is enough to cover the normal current				
End-to-end Accuracy	± 1.5 %				

* The minimum pulse width is not provided but speculated to be at least 50 ms. Contact a Siemens representative for more details.

Make sure that the device will cover the peak demand kW, will not generate more pulses than the maximum pulse rate and will maintain the signal pulse width at least for the minimum pulse width duration.

Notes on installation:

- Install CT sensors on the electrical main panel. Follow the manufacturer's instructions.
- Terminate the Watt-Hour Transducer output at the Terminal Block. Follow the manufacturer's instructions.
- Install the Watt Hour Transducer and terminate the CT sensor outputs at the WHT inputs. Follow the manufacturer's instructions.
- Electrical shock can occur from CT's without a shunt resistor.

Chart A-3. Electrical Consumption and Demand Monitoring Using a Watt Hour Transducer

Example of Watt Hour Transducer Specifications

The following Watt-Hour Transducer has been used successfully.

Watt Hour Transducer		
Ohio Semitronics, Inc.		
WL-3968		
Input	Current	Output from Current Transformer 0 - 0.333 V
	Voltage	120/208 & 277/480
	Phase	Three-Phase, Three-Wire or Three-Phase, Four-Wire
	Range	± 15%
	Burden	None
	Power Factor	0.5 Lead to 0.5 Lag
	Instrument Power	208/240/480, 50/60 Hz, 2.5 Watts
Output	Relay	Dry Contact, 120 V, 0.3 A, 10 VA Max
	Closure Duration	250 Milliseconds
	Accuracy	± 0.5% F.S.
	Isolation	Input/Output/Case 750 VAC
	Temperature Effects	(-20°C to +60°C) ± 0.02%/°C

Chart A-3. Electrical Consumption and Demand Monitoring Using a Watt Hour Transducer (continued)

Example of Current Transducer Specifications

The following Current Transducer has been successfully used.

Current Transducer		
Sentran Corporation		
4LS3 Split Bus Bar		
Input	Current	AC current, sine wave, single phase 60 Hz, Load PF 0.5-1 lead or lag 100, 200, 300, 400, 500, 600, 800, 1K, 1.5K, 2K, 2.5K and 3K Amp
	Voltage rating	600 V ac Tested Per ANSI C57.13 BIL 10 kV AC Full Wave for 60 seconds
	Bandwidth	10 Hz to 1000 Hz ± 3 dB
Output	Voltage	100 mV, 250 mV, 333 mV, 500 mV, 1 V and 5 V
	Limiting	20 V AC RMS
	Accuracy	± 1% ratio and linearity accuracy from 5% to 200% of scale
	Phase Displacement	± 1 degree
	Output Resistance	< 100 Ohms
	Interface Resistance	> 10K Ohms
	Lead Wires	20 or 22 AWG UL1015, 600V insulation, 105 C

Chart A-4. Electrical Consumption and Demand Monitoring Using a Watt Hour Transducer

EMCS Programming Steps

Summary

Step 1. Set-up an external pulse input (LPACI) point in EMCS to accumulate daily consumption for Wh-to-pulse transducer.

Step 2. Set-up an internal analog output (LAO) point to accumulate monthly consumption from external point created in Step 1.

Step 3. Add a programming step to update the point value created in Step 2 every 15 minutes.

Step 4. Create a trend point extension on the internal analog output point in the EMCS to record the 15-minute accumulated consumption values.

Details of these steps follow.

Step 1. Set-up an external pulse input (PI) point in EMCS to accumulate daily consumption for Wh-to-pulse transducer.

In Insight Apogee, perform the following steps:

a. Connect installed sensors to the controller

b. Select "Point Editor", then in the Point Menu select "New", then "LPACI (Logical Pulse Accumulator Input)"

c. The new point window editor will be displayed. Set the following parameters as specified below:

<table>
<tr><th></th><th colspan="2">MBC</th><th>RBC</th><th>MEC</th><th>SCU</th><th>UC</th></tr>
<tr><td>System Name</td><td colspan="6">Enter a name up to 30 characters in length. For example, BLDG1.elec</td></tr>
<tr><td>Point Name</td><td colspan="6">Enter a name up to 30 characters in length. For example, BLDG1.kWh</td></tr>
<tr><td>Field Panel</td><td colspan="6">Click the button to show a list of field panels on the network. Select the name of the field panel that contains the point</td></tr>
<tr><td>Descriptor</td><td colspan="6">Enter up to 16 characters in length to provide some additional explanation about the application or location of the point</td></tr>
<tr><td rowspan="2">Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)</td><td colspan="6">L . DDD . PPPPP
L: FLN number, 0-3
D: Drop number, 0-099
P: Point number, 0-65,000</td></tr>
<tr><td colspan="2">L is equal to 0
D is the address key number in the PTM (Point Termination Module)
P is the actual hardware layout number</td><td>L is equal to 0
D is equal to 0 if point resides in MEC, or FLN number
P can be 5-8.</td><td>L is equal to 0
D is the termination board number
P is the termination point number</td><td>L is FLN connecting number on field panel
D is FLN device number
P is the termination point number</td></tr>
<tr><td>Engineering Unit</td><td colspan="6">kWh</td></tr>
<tr><td>Invert Value</td><td colspan="6">No</td></tr>
<tr><td>Count Both Edges</td><td colspan="6">No</td></tr>
<tr><td>Gain</td><td colspan="6">Value/pulse. For example, if a pulse from WHT is equal to 100 Wh, the gain is equal to 0.1 (the engineering unit is kWh)</td></tr>
<tr><td>Initial Value</td><td colspan="6">0</td></tr>
<tr><td>COV Limit</td><td colspan="6">At least equal to gain number</td></tr>
</table>

Step 2. Set-up an internal logical analog output (LAO) point to accumulate monthly consumption from the external point created in Step 1.

In Insight Apogee, perform the following steps:

a. Select "Point Editor", then Point Menu select "New", then "LAO (Logical Analog Output)"

b. New point window editor will be displayed. Set the following parameters as specified below:

	MBC	RBC	MEC	SCU	UC
System Name	Enter a name up to 30 characters in length. For example, BLDG1.elec				
Point Name	Enter a name up to 30 characters in length. For example, BLDG1.kWh1				
Field Panel	Click the button to show a list of field panels on the network, then select name of the field panel that contains the point				
Descriptor	Enter up to 16 characters in length to provide some additional explanation about the application or location of the point				
Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)	Check (P) box and (V) is displayed in the field. Insight will automatically assign an address to this virtual point.				
Engineering Unit	kWh				
COV Limit	At least equal to Gain number of the above LPACI point				
Initial Value	0				
Totalization	Hourly				
	• Leave all other items at their default value and click "OK."				

Step 3. Add a programming step to update the point value created in Step 2 every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Program Editor”, then in the Program Menu select “New”
b. New program window editor will be displayed, enter the PPCL program lines (See Appendix A). Press Enter at the end of each program line
c. From Program Menu select “Save As.”

Set the following parameters as specified below.

System Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Field Panel	Click the button to show a list of field panels on the network, then select name of the field panel that contains the point
	• Click “OK”

Step 4. Create a trend point extension on the internal analog output point in the EMCS to record the 15-minute accumulated consumption values.

In Insight Apogee, perform the following steps:

a. Select “Trend Definition Editor” from the Trend Menu and select “New”.
b. The Object Selector appears, select the LAO point above and click “OK”.
c. The Trend Type dialog box appears, select “COV” and click “OK”.
d. The Add COV Definition dialog box appears.

Set the following parameters as specified below.

Panel Samples Desired	300 samples (Panel can keep data for 3 days) or the Maximum Samples available at Panel, whichever is less
Trend COV Limit	Select “Use Trend COV Limit” with 0.01 value
PC Buffer size	1000 (PC can keep data for 10 day) or the maximum Insight Storage number, whichever is less
Enable PC Collection	Check this box to enable PC for data collection
Enable “COV Buffer Full” Notification	Check this box to enable control panel to notify Insight when the trend buffer has reached 80% full
	• Click “OK” to close the Add COV Definition dialog box
	• Click “OK” to the Operation Successful message

Application B. Electrical Consumption Monitoring Using a Watt Transducer

Charts B-1 through B-4 will take the user through steps to set-up a Watt Transducer to monitor electrical consumption and demand. Following these steps will enable the EMCS to measure electrical consumption (kWh) and store fifteen-minute data. Chart B-1 lists the needed equipment and will help the user determine if the controller has an available input slot. Chart B-2 aids the user in choosing a Watt Transducer (WT) and a Current Transducer (CT). The chart lists the accuracy, output type, wire specifications, and sensor specifications for the different controller models. Tips for CT installation are also provided. Chart B-3 provides an example of a WT with a CT available in the market. Chart B-4 provides the EMCS programming steps. By following these steps, the user will enable the EMCS to accumulate daily consumption, display current demand, and record 15-minute consumption. The user should proceed to Application F to set-up the data collection and history data storage.

Step 1. Check the input slot availability on the controller.

Use Chart B-1 to find which slots are needed on the controller. The position of the slot can be found in Chart B-1 under Controller Terminal Connections. For example, the RBC has 12 modules enclosure size. If there is a slot available, PTM6.2I420 will be installed. If there are no available slots, contact a Siemens representative to determine whether an expansion I/O module can be added to this controller or if an additional controller should be installed.

Step 2. Choose a Watt Transducer (WT) and Current Transducer (CT).

Chart B-2 lists the WT and CT specifications. For example, an acceptable Watt Transducer for RBC should have analog output (preferred current 4-20 mA) with 0.5% accuracy or better. With matching CT output and accuracy selection of 1% or better, the end-to-end accuracy from the transducers to the RBC controller is at least 1.5% plus the accuracy of RBC current input. Note that to gain this accuracy the transducers must be placed no more

than 750 ft. away with 14-22 AWG wire type. Chart B-3 shows an example of WT provided in the market. This Watt Transducer example includes the CT.

Step 3. Follow the EMCS programming steps.

Chart B-4 provides the steps to set-up the EMCS to accumulate daily consumption, accumulate monthly consumption, and update the values every fifteen minutes. Detailed steps provided in this chart must be followed to set-up the external analog input points and internal analog output points.

Step 4. Finally, follow the steps in Application F.

Application F lists the steps to set-up the data collection and history data storage.

After completing the above steps, the EMCS system can accumulate daily consumption, display current demand, and record 15-minute consumption.

Chart B-1. Electrical Consumption Monitoring Using a Watt Transducer

Verify that in addition to the sensors and transducer, that the controller has the available slots as discussed below.

	MBC	RBC	MEC	SCU	UC
What is measured	Electrical consumption data of either One-Phase or Three Phase, 208 to 480 VACrms, 2400 amps (max), 50/60 Hz				
What is stored in EMCS	Fifteen-minute data of electrical consumption in kWh unit stored in Trend Data History.				
What is needed	3 - CT sensor 1 - Watt Transducer 1 – available slot on Terminal Block (for external analog input) 1 – available internal analog output point (to accumulate month-to-date consumption)				
Terminal Connections	PTM6.2I420	PTM6.2I420	AI 17 – AI 24	TB2-5 AI-00 to AI-15	I/O card1: UI13–UI16 I/O card2: UI33–UI36

Chart B-2. Electrical Consumption Monitoring Using a Watt Transducer

Watt Transducer and Current Transducer Specifications

	MBC	RBC	MEC	SCU	UC
Output Type from Watt Transducer	Analog, 4-20 mA				
Accuracy from Watt Transducer	± 0.5 % (not including CT's)				
Maximum Wire Length (ft.)	750 ft. @ 14-22 AWG				
CT Accuracy	± 1.0 %				
Note	CT sensors • Output: Match the input type for Watt Transducer • Input: Make sure that input current is enough to cover the normal current				
End-to-end Accuracy	± 1.5 % plus the accuracy of the analog reading of each controller. Contact Siemens representative for specific information.				

Make sure that the device will cover the peak demand kW, will not generate more pulses than the maximum pulse rate and will maintain the signal pulse width at least for the minimum pulse width duration.

Notes on installation:

- Install CT sensors on the electrical main panel, and follow the manufacturer's instructions.
- Install Watt Transducer and terminate CT sensors outputs at the WT inputs, and follow the manufacturer's instructions.
- Electrical shock can occur from CT's without a shunt resistor.
- Terminate Watt Transducer output at Terminal Block, and follow the manufacturer's instructions.

Chart B-3. Electrical Consumption Monitoring Using Watt Transducer

Example of Watt Transducer Specifications

Watt Transducer (CT included)		
Veris Industries, Inc.		
H-8040		
Input	Primary Voltage	208 or 480 V ac rms.
	Phase	One-Phase or Three-Phase
	Primary Current	Up to 2400 amps cont. per phase
Output	Type	4 – 20 mA
	Supply Power	9 – 30 V dc; 30 mA max
	Accuracy	± 1%
	Internal Isolation	2000 V ac rms.
	Case Insulation	600 V ac rms.
	Current Transformer	Split core, 100, 300, 400, 800, 1600 or 2400 amps

Chart B-4. Electrical Consumption Monitoring Using a Watt Transducer

EMCS Programming Steps

Summary

1. Set-up an external analog input (LAI) point in EMCS to store demand from the Watt transducer.
2. Set-up an internal analog output point in EMCS to accumulate monthly consumption from the Watt Transducer.
3. Add a programming step to accumulate the point value created in Step 1 and store in the point created in Step 2. This process will occur every 15 minutes.
4. Create Trend point extension on internal analog output point in EMCS to record 15-minute accumulated consumption values.

Details of these steps follow.

Step 1. Set-up external analog input (LAI) point in EMCS to store demand from the Watt Transducer.

In Insight Apogee, perform the following steps:

a. Connect installed sensors to the controller.
b. Select "Point Editor", then in the Point Menu select "New", then "LAI (Logical Analog Input)."
c. New point window editor will be displayed.

Set the following parameters as specified below:

<table>
<tr><th></th><th>MBC</th><th>RBC</th><th>MEC</th><th>SCU</th><th>UC</th></tr>
<tr><td>System Name</td><td colspan="5">Enter a name up to 30 characters in length. For example, BLDG1.elec</td></tr>
<tr><td>Point Name</td><td colspan="5">Enter a name up to 30 characters in length. For example, BLDG1.kWh1</td></tr>
<tr><td>Field Panel</td><td colspan="5">Click the button to show a list of field panels on the network, then select name of the field panel that contains the point</td></tr>
<tr><td>Descriptor</td><td colspan="5">Enter up to 16 characters in length to provide some additional explanation about the application or location of the point</td></tr>
<tr><td rowspan="2">Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)</td><td colspan="5">L . DDD . PPPPP
L: FLN number, 0-3
D: Drop number, 0-099
P: Point number, 0-65,000</td></tr>
<tr><td colspan="2">L is equal to 0.
D is the address key number in the PTM (Point Termination Module).
P is the actual hardware layout number.</td><td>L is equal to 0.
D is equal to 0 if point resides in MEC, or FLN number
P can be 17-24.</td><td>L is equal to 0.
D is the termination board number.
P is the termination point number.</td><td>L is FLN connecting number on field panel.
D is FLN device number.
P is the termination point number.</td></tr>
<tr><td>Engineering Unit</td><td colspan="5">kW</td></tr>
<tr><td>Slope/Intercept</td><td colspan="5">Choose Slope/Intercept button to open Slope Intercept Calculator dialog box with following parameters</td></tr>
</table>

	MBC	RBC	MEC	SCU	UC
Calculate Based On	MBC/RBC		MEC	SCU	UC
Sensor Type	Current				
Calculate Using	English				
Signal Range	Low Value: 4 High Value: 20 (in mA unit)				
Device Range	Low Value: the kW value corresponding to the low signal from sensor High Value: the kW value corresponding to the high signal from sensor For instance, Watt Transducer is set-up to send out signal 0 kW demand at 4 mA and 500 kW demand at 20 mA, the low value in this case is 0 and the high value is 500.				
	• Click “Calculate” button to calculate the slope and intercept value				
	• Click “OK” to return to point window				
COV Limit	10 times of slope value				
Sensor Type	Current				
Totalization Rate	Hourly				
	• From the Point menu, select “Save”				

Step 2. Set-up an internal analog output point in EMCS to accumulate monthly consumption from the Watt Transducer.

In Insight Apogee, perform the following steps:

a. Select "Point Editor", then in the Point Menu select "New", then "LAO (Logical Analog Output)".

b. New point window editor will be displayed. Set the following parameters as specified below:

	MBC	RBC	MEC	SCU	UC
System Name	Enter a name up to 30 characters in length. For example, BLDG1.elec				
Point Name	Enter a name up to 30 characters in length. For example, BLDG1.kWh1				
Field Panel	Click the button to show a list of field panels on the network, then select name of the field panel that contains the point				
Descriptor	Enter up to 16 characters in length to provide some additional explanation about the application or location of the point				
Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)	Check (P) box and (V) is displayed in the field. Insight will automatically assign an address to this virtual point.				
Engineering Unit	kWh				
COV Limit	Equal to COV Limit of the above LAI point				
Initial Value	0				
Totalization	Hourly				
	Leave all other items at their default value and click "OK."				

Step 3. Add a programming step to accumulate the point value created in Step 1 and store in the point created in Step 2.

This process will occur every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Program Editor”, then in the Point Menu select “New”, then “LAO (Logical Analog Output)”.
b. New program window editor will be displayed, enter the PPCL program lines (See Appendix B). Press Enter at the end of each program line.
c. When finished, from Program Menu select “Save As”. The Save As dialog box displays with the following parameters.

	MBC	RBC	MEC	SCU	UC
System Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption				
Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption				
Field Panel	Click the button to show a list of field panels on the network, then select the name of the field panel that contains the point				
	• Click “OK”				

Step 4. Create Trend point extension on internal analog output point in EMCS to record 15-minute accumulated consumption values.

In Insight Apogee, perform the following steps:

a. Select “Trend Definition Editor”. From the Trend Menu, select “New”.
b. From the Object Selector displays, select the LAO point above and click “OK”.
c. When the Trend Type dialog box displays, select “COV” and click “OK”.
d. The Add COV Definition dialog box displays. Set the following parameters as specified below:

Panel Samples Desired	300 samples (Panel can keep data for 3 days) or the Maximum Samples available at Panel, whichever is less
Trend COV Limit	Select “Use Trend COV Limit” with 0.01 value
PC Buffer size	1000 (PC can keep data for 10 days) or the maximum Insight Storage number, whichever is less
Enable PC Collection	Check this box to enable PC for data collection
Enable “COV Buffer Full” Notification	Check this box to enable control panel to notify Insight when the trend buffer has reached 80% full
	Click “OK” to close the Add COV Definition dialog box
	Click “OK” to the Operation Successful message

Application C. Thermal Consumption Monitoring Using a BTU Meter

Charts C-1 through C-4 will take the user through steps to set-up a BTU meter to monitor thermal consumption. Following these steps will enable the EMCS to measure thermal consumption (MMBtu) and store fifteen-minute data. Chart C-1 lists the needed equipment and will help the user determine if the controller has an available input slot. Chart C-2 aids the user in choosing a BTU meter, temperature sensors, and a flow meter. The chart lists the output type, pulse widths, and pulse rates for the different controller models that the BTU meter must have. The table also provides recommended temperature sensor and flow meter accuracy. Tips for BTU meter selection and flow meter installation are provided at the end. Chart C-3 provides an example of a BTU meter, a temperature sensor, and a flow meter available in the market. Chart C-4 provides the EMCS programming steps. By following these steps, the user will enable the EMCS to collect daily and monthly consumption. The user should proceed to Application F to set-up the data collection and history data storage.

Step 1. Check the input slot availability on the controller.

Use Chart C-1 to find which slots are needed on the controller. The position of the slot can be found in Chart C-1 under Terminal Connections. For example, the MEC has an input / output point board, which supports eight digital inputs. In this board, the eight inputs-only terminal connection, DI5 – DI8, are pulse accumulator inputs. If there is a slot available, the procedure can be followed. If there are no slots available, contact a Siemens representative to determine whether an expansion I/O module can be added to this controller or if an additional controller should be installed.

Step 2. Choose a BTU meter, temperature sensor and flow meter.

Chart C-2 lists the BTU meter, temperature sensor and flow meter specifications. For example, an acceptable BTU meter for MEC should have digital output with at least 20 ms pulse width at 25 Hz maximum pulse rate. This BTU meter should be installed with matching temperature sensors and flow meter output at the recommended accuracy. The

end-to-end accuracy of this thermal measurement depends on the meter and sensors as well as the characteristics of the system (differential temperature). Chart C-2 and Appendix B provide more information regarding this. Chart C-3 shows examples of a BTU meter, temperature sensors and a flow meter provided in the market.

Step 3. Follow the EMCS programming steps.

Chart C-4 provides the steps to set-up the EMCS to collect daily and monthly consumption, update the data every fifteen minutes, and record the consumption values. Detailed steps provided in this chart must be followed to accomplish these tasks.

Step 4. Finally, follow the steps in Application F.

Application F lists the steps to set-up the data collection and history data storage.

After following the above steps, the EMCS system can collect daily and monthly consumption.

Chart C-1. Thermal Consumption Monitoring Using a BTU Meter

Verify that in addition to the sensors and transducer, that the controller has the available slots as discussed below.

	MBC	RBC	MEC	SCU	UC
What is measured	• Chilled/Hot water flow • Chilled/Hot water supply and return temperature				
What is stored in EMCS	• Fifteen-minute data of Thermal Consumption in MMBtu units stored in Trend Data History				
What is needed	1 – Flow meter 2 – Temperature sensors 1 – BTU meter 1 – available slot on Terminal Block (for digital input) 1 – available internal analog output point (to accumulate month-to-date consumption)				
Terminal Connections	PTM6.2C	PTM6.2C	DI 5 – DI 8	TB1 DI-24 to DI-29	I/O card1: DI10–DI12 I/O card2: DI30–DI32

Chart C-2. Thermal Consumption Monitoring Using a BTU Meter

Btu Meter, Flow Meter and Temperature Sensor Specifications

	MBC	RBC	MEC	SCU	UC
Output Type from BTU Meter	Digital (each pulse is equal to xxx MMBtu, varies with specific sensor)				
Maximum Pulse Rate	25 Hz	25 Hz	25 Hz	25 Hz	10 Hz
Minimum Pulse Width	20 ms	20 ms	20 ms	20 ms	N/A*
Maximum Wire Length (ft.)	750 ft. @ 14-22 AWG				
Flow meter accuracy	Recommended accuracy for the flow meter is ±1% full scale				
Temperature sensor accuracy	• Recommended accuracy for chilled water temperature sensors is ± 0.2 °F • Recommended accuracy for hot water temperature sensor is ± 0.5 °F				
End-to-end accuracy	The end-to-end accuracy depends on the accuracy of the temperature sensors, flow meter and how large the temperature difference is. Assuming a difference between chilled water supply and return temperature of 10 °F, the end-to-end accuracy can approach 5%. Assuming a difference between hot water supply and return temperature of 20 °F, the accuracy can approach 7%, without end-to-end calibration. See Appendix B				

* The minimum pulse width is not provided but speculated to be at least 50 ms. Contact a Siemens representative for more details.

Tips on BTU Meter selection:

- Ensure that the BTU meter will cover the peak BTU, will not generate pulses more than the maximum pulse rate and will maintain the output pulse signal with at least the minimum pulse width duration.
- Use matched temperature sensors.
- Temperature sensor and flow meter outputs are correct for the BTU meter inputs.

Notes on installation:

- Install a flow meter on the supply pipe or return pipe.
- Install matched temperature sensors, one on the supply pipe and another on the return pipe.
- For the temperature sensor on the same pipe as the flow meter, install the sensor close to the flow meter.
- Disconnect the flow meter and temperature sensors at the BTU meter input board. Follow the manufacturer's instructions.
- Disconnect the BTU meter at the terminal block. Follow the manufacturer's instructions.

Chart C-3. Thermal Consumption Monitoring Using a BTU Meter

An Example of a BTU Meter, Flow Meter and Temperature Sensor Specifications

The following BTU meter, flow meter and temperature sensors have been used successfully.

Btu Measurement System		
Keegan Electronics, Inc.		
System 90 Series		
Input	Temperature	2 match temperature sensors supplied by Keegan Electronics
	Minimum Resolution of Temperature reading	0.1°C
	Flow	1 flow sensor supplied by Data Industrial
	Minimum Closure Duration	2 milliseconds
	Maximum Length of cable	500 feet
	Electrical	Connect to high voltage (120 V AC) through a circuit breaker
Output	Standard Output	Monostable relay outputs, SPST, 2A @ 120 V AC resistive representing BTU's and Gallons
	Optional Output	0-1 mA DC or 4-20 mA DC representing instantaneous BTU/HR and GPM
	Accuracy	Depends on the accuracy of temperature sensor, flow meter and how large the temperature difference is.

Temperature Sensor		
Keegan Electronics, Inc.		
RTD for System 90 Series		
Input	Temperature Range	0-100 °C
Output	Standard Output	RTD – variable resistance
	Reference	@ 0°C – output is equal to 32,654 ohms @ 100°C – output is equal to 679 ohms
	Accuracy	± 0.2 °C

Chart C-3. Thermal Consumption Monitoring Using a BTU Meter (continued)

Example of BTU Meter, Flow Meter and Temperature Sensor Specifications

Flow Sensor		
Data Industrial		
220 PVCS Insert Flow Sensor		
Input	Flow Rate	1 to 30 ft./sec
	Maximum Pressure	100 psi @ 68°F
	Maximum Temperature	140°F @ 40 psi
	Maximum Length of cable	20 feet shielded twisted pair AWG 20
Output	Standard Output	Voltage pulse, 5V or greater
	Accuracy	± 1% of Full Scale (over recommended design flow range)
	Absolute Accuracy	± 4% of reading within calibration range
	Linearity	± 1%
	Frequency	3.2 – 200 Hz
	Pulse Width	5 milliseconds ± 25%

Chart C-4. Thermal Consumption Monitoring Using a BTU Meter

EMCS Programming Steps

Summary

1. Set-up an external pulse input (LPACI) point in EMCS to accumulate daily consumption for the BTU meter.
2. Set-up an internal analog output (LAO) point to accumulate monthly consumption from the external point created in Step 1.
3. Add a programming step to update the accumulated monthly consumption value every 15 minutes.
4. Create Trend point extension on the internal analog output point in the EMCS to record 15-minute accumulated consumption values.

Details of these Steps follow.

Step 1. Set-up external pulse input (LPACI) point in EMCS to accumulate daily consumption for the BTU meter.

In Insight Apogee, perform the following steps:

a. Connect installed sensors to the controller.

b. Select "Point Editor". Then in the Point Menu select "New", then "LPACI (Logical Pulse Accumulator Input)".

c. The new point window editor will be displayed. Set the following parameters as specified below.

<table>
<tr><th></th><th colspan="2">MBC</th><th>RBC</th><th>MEC</th><th>SCU</th><th>UC</th></tr>
<tr><td>System Name</td><td colspan="6">Enter a name up to 30 characters in length. For example, BLDG1.therm</td></tr>
<tr><td>Point Name</td><td colspan="6">Enter a name up to 30 characters in length. For example, BLDG1.chwmmbtu</td></tr>
<tr><td>Field Panel</td><td colspan="6">Click the button to show a list of field panels on the network, then select name of the field panel that contains the point</td></tr>
<tr><td>Descriptor</td><td colspan="6">Enter up to 16 characters in length to provide some additional explanation about the application or location of the point</td></tr>
<tr><td rowspan="2">Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)</td><td colspan="6">L . DDD . PPPPP
L: FLN number, 0-3
D: Drop number, 0-099
P: Point number, 0-65,000</td></tr>
<tr><td colspan="2">L is equal to 0.
D is the address key number in the PTM (Point Termination Module).
P is the actual hardware layout number.</td><td>L is equal to 0.
D is equal to 0 if point resides in MEC, or FLN number
P can be 5-8.</td><td>L is equal to 0.
D is the termination board number.
P is the termination point number.</td><td>L is FLN connecting number on field panel
D is FLN device number.
P is the termination point number.</td></tr>
<tr><td>Engineering Unit</td><td colspan="6">MMBtu</td></tr>
<tr><td>Invert Value</td><td colspan="6">No</td></tr>
<tr><td>Count Both Edges</td><td colspan="6">No</td></tr>
<tr><td>Gain</td><td colspan="6">Value/pulse. For example, if a pulse from BTU meter is equal to 0.01 MMBtu, Gain is equal to 0.01</td></tr>
<tr><td>Initial Value</td><td colspan="6">0</td></tr>
<tr><td>COV Limit</td><td colspan="6">At least equal to Gain number</td></tr>
</table>

Step 2. Set-up internal analog output point in EMCS to accumulate monthly consumption from the BTU meter.

In Apogee Insight, perform the following steps:

a. Select "Point Editor". Then in the Point Menu select "New", then "LAO (Logical Analog Output)".

b. The new point window editor will be displayed. Set the following parameters as specified below:

System Name	Enter a name up to 30 characters in length. For example, BLDG1.therm
Point Name	Enter a name up to 30 characters in length. For example, BLDG1.chwmmbtu1
Field Panel	Click the button to show a list of field panels on the network. Then select name of the field panel that contains the point
Descriptor	Enter up to 16 characters in length to provide some additional explanation about the application or location of the point
Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)	Check (P) box and (V) is displayed in the field. Insight will automatically assign an address to this virtual point.
Engineering Unit	MMBtu
COV Limit	At least equal to Gain number of the above LPACI point
Initial Value	0
Totalization	Hourly
	Leave all other items at their default value and click "OK."

Step 3. Add a programming step to update the accumulated monthly consumption value every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Program Editor”. Then in the Program Menu select “New”.
b. Enter the PPCL program lines (See Appendix A) in the new program window editor that is displayed. Press enter at the end of each program line.
c. From Program Menu select “Save As”. The Save As dialog box will be displayed.

Set the following parameters as specified below:

System Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Field Panel	Click the button to show a list of field panels on the network, then select the name of the field panel that contains the point
	Click “OK”

Step 4. Create the trend point extension on the internal analog output point in EMCS to record accumulated consumption values every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Trend Definition Editor”. From the Trend Menu select “New”.

b. The Object Selector will be displayed. Select the LAO point above, and click “OK”.

c. The Trend Type dialog box will be displayed. Select “COV”, and click “OK”.

d. The Add COV Definition dialog box will be displayed. Set the parameters as specified below:

Panel Samples Desired	300 samples (Panel can keep data for 3 days) or the Maximum Samples available at Panel, whichever is less
Trend COV Limit	Select “Use Trend COV Limit” with 0.01 value
PC Buffer size	1000 (PC can keep data for 10 days) or the maximum Insight Storage number, whichever is less
Enable PC Collection	Check this box to enable PC for data collection
Enable “COV Buffer Full” Notification	Check this box to enable control panel to notify Insight when the trend buffer has reached 80% full
	Click “OK” to close the Add COV Definition dialog box
	Click “OK” to the Operation Successful message

Application D. Thermal Consumption Monitoring Using an EMCS

Charts D-1 through D-4 will provide the user with steps to set-up an EMCS to monitor thermal consumption. By following these steps, the user will enable the EMCS to measure thermal consumption (MMBtu) and store fifteen-minute data. Chart D-1 lists the needed equipment and will help the user determine if the controller has an available input slot. Chart D-2 aids the user in choosing temperature sensors and a flow meter. The chart lists the temperature sensor and flow meter accuracy and output type. Tips for temperature sensor and flow meter installation are provided as well. Chart D-3 provides an example of a temperature sensor and a flow meter available in the market. Chart D-4 provides the EMCS programming steps. By following these steps, the user will enable the EMCS to accumulate monthly thermal consumption. The user should then proceed to Application F to set-up the data collection and history data storage.

Step 1. Check the input slot availability on the controller.

Use Chart D-1 to find which slots are needed on the controller. The position of the slot can be found in Chart D-1 under Controller Terminal Connections. For example, the SCU needs three available slots either on AI-00 to AI-15 on TB2, TB3, TB4 or TB5. If there are no available slots, contact a Siemens representative to determine whether an expansion I/O module can be added to this controller or if an additional controller should be installed.

Step 2. Choose a Temperature Sensor and Flow Meter.

Chart D-2 lists the temperature sensor and flow meter specifications. For example, an acceptable temperature sensor and flow meter for SCU should have analog output and either current or voltage output. The recommended accuracy for a chilled water temperature sensor is 0.2 °F, while the recommended accuracy for a hot water temperature sensor is 0.5 °F. The end-to-end accuracy of this thermal measurement does not depend only on the meter and sensors but also the characteristics of the system (differential temperature). Chart D-2 and Appendix B provide more information regarding this. Chart D-3 shows an example of temperature sensors and a flow meter provided in the market.

Step 3. Follow the EMCS programming steps.

Chart D-4 provides the steps to set-up the external input points (from the temperature sensor and flow meter) and internal points used to store the consumption that the EMCS must recognize. Detailed steps provided in this chart must be followed in order to set-up the external input point and internal points.

Step 4. Follow the steps in Application F.

Application F lists the steps to set-up the data collection and history data storage.

After these steps are complete, the system can collect and store monthly thermal consumption data.

Chart D-1. Thermal Consumption Monitoring Using EMCS

Verify that in addition to the sensors and transducer, the controller has the available slots as discussed below.

<table>
<tr><th></th><th>MBC</th><th>RBC</th><th>MEC</th><th>SCU</th><th>UC</th></tr>
<tr><td>What is measured</td><td colspan="5">• Chilled/Hot water flow
• Chilled/Hot water supply and return temperature</td></tr>
<tr><td>What is stored in EMCS</td><td colspan="5">• Fifteen-minute data of Thermal Consumption in MMBtu units stored in Trend Data History</td></tr>
<tr><td>What is needed</td><td colspan="5">1 – Flow meter
2 – Temperature sensors
3 – available slot on Terminal Block (for external analog input)
1 – available internal analog output point (to calculate instantaneous thermal consumption)
1 – available internal analog output point (to accumulate month-to-date consumption)</td></tr>
<tr><td>Terminal Block for Current Analog Input</td><td colspan="2">PTM6.2I420</td><td rowspan="2">AI 17 – AI 24</td><td rowspan="2">TB2-5
AI-00 to AI-15</td><td rowspan="2">I/O card1: UI13–UI16
I/O card2: UI33–UI36</td></tr>
<tr><td>Terminal Block for Voltage Analog Input</td><td colspan="2">PTM6.2U10</td></tr>
</table>

Chart D-2. Thermal Consumption Monitoring Using EMCS

Flow Meter and Temperature Sensor Specifications

	MBC	RBC	MEC	SCU	UC
Output Type from Flow Meter	Analog, either voltage or current output				
Output Type from Temperature Sensors	Analog, current output				
Maximum Wire Length (ft.)	750 ft. @ 14-22 AWG				
Temperature Sensor Accuracy	• Recommended accuracy for chilled water temperature sensor: ± 0.2 °F • Recommended accuracy for hot water temperature sensor: ± 0.5 °F				
Flow Meter Accuracy	• Recommended accuracy for flow meter 1% full scale				
End-To-End Accuracy	The end-to-end accuracy depends on the accuracy of temperature sensors, flow meter and how large the temperature difference is. Assuming the difference between the chilled water supply and return temperature is 10 °F, the end-to-end accuracy can approach 5%. Assuming the difference between hot water supply and return temperature is 20 °F, the accuracy can approach 7%, without end-to-end calibration. See Appendix B				

Notes on installation:

- Install flow meter on the supply pipe or the return pipe.
- Install matched temperature sensors, one on the supply pipe and another on the return pipe.
- For the temperature sensor on the same pipe as the flow meter, install the sensor close to the flow meter.
- Disconnect the flow meter and temperature sensors at the Terminal Block. Follow the manufacturer's instructions.

Chart D-3. Thermal Consumption Monitoring Using an EMCS

An Example of Flow Meter and Temperature Sensor Specifications

The following Flow Meter and Temperature sensors have been used successfully.

Temperature Sensor		
Minco Products, Inc		
RTD with TempTran transmitter		
Input	Temperature Range	30-80 °F (for chilled water system)
Output	Standard Output	Current, 4-20 mA
	Accuracy	± 0.2 % of span

Flow Meter and Transmitter		
Rosemount		
8705 with the integral mounted type transmitter model 8732		
Input	Flow Rate	0.04 to 30 ft./sec
	Maximum Pressure	285 psi @ 100°F
	Temperature Condition	Natural Rubber Lining: 0 to 185 °F
	Minimum Liquid Conductivity	5 microsiemens/cm
Output	Standard Output	Current, 4-20 mA
	Accuracy	± 0.5% of rate from 1 to 30 ft/sec and ± 0.005 ft/sec from 0.04 to 1 ft/sec

Chart D-4. Thermal Consumption Monitoring Using EMCS

EMCS Programming Steps

Summary

1. Set-up external analog input (LAI) points in EMCS for flow meter and temperature sensors.
2. Set-up an internal analog output (LAO) point to store the instantaneous consumption value.
3. Add a programming step that will use the LAI points from Step 1 to calculate for instantaneous consumption and store the LAO point value from Step 2.
4. Set-up an internal analog output (LAO) point to collect monthly consumption data.
5. Add a programming step to update the point in Step 4 every 15 minutes.
6. Create a Trend point extension on the internal analog output point in EMCS to record consumption values every 15 minutes.

Details of these steps follow.

Step 1. Set-up external analog input (LAI) points in EMCS for flow meter and temperature sensors.

In Insight Apogee, perform the following steps: Connect the installed sensors to the controller.

a. Select “Point Editor”. In the Point Menu, select “New” then “LAI (Logical Analog Input)”.

b. The new point window editor will be displayed. Set the following parameters as specified below:

<table>
<tr><td>System Name</td><td colspan="4">Enter a name up to 30 characters in length. For example, BLDG1.therm</td></tr>
<tr><td>Point Name</td><td colspan="4">Enter a name up to 30 characters in length. For example, BLDG1.chwmmbtu1</td></tr>
<tr><td>Field Panel</td><td colspan="4">Click the button to show a list of field panels on the network, then select name of the field panel that contains the point</td></tr>
<tr><td>Descriptor</td><td colspan="4">Enter up to 16 characters in length to provide some additional explanation about the application or location of the point</td></tr>
<tr><td rowspan="2">Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)</td><td colspan="4">L . DDD . PPPPP
L: FLN number, 0-3
D: Drop number, 0-099
P: Point number, 0-65,000</td></tr>
<tr><td>L is equal to 0.
D is the address key number in the PTM (Point Termination Module).
P is the actual hardware layout number.</td><td>L is equal to 0.
D is equal to 0 if point resides in MEC, or FLN number
P can be 17-24.</td><td>L is equal to 0.
D is the termination board number.
P is the termination point number.</td><td>L is FLN connecting number on field panel
D is FLN device number.
P is the termination point number.</td></tr>
<tr><td>Engineering Unit</td><td colspan="4">GPM for flow meter and °F for temperature sensors</td></tr>
<tr><td>Slope/Intercept</td><td colspan="4">Choose Slope/Intercept button to open Slope Intercept Calculator dialog box with the following parameters</td></tr>
<tr><td>Calculate Based On</td><td>MBC/RBC</td><td>MEC</td><td>SCU</td><td>UC</td></tr>
<tr><td>Sensor Type</td><td colspan="4">Current or Voltage depend on input type</td></tr>
<tr><td>Calculate Using</td><td colspan="4">English</td></tr>
<tr><td>Signal Range</td><td colspan="4">Low Value: 4 for current and 0 for voltage
High Value: 20 for current and 5 or 10 for voltage</td></tr>
<tr><td>Device Range</td><td colspan="4">Low Value: the kW value corresponding to the low signal from sensor
High Value: the kW value corresponding to the high signal from sensor
For instance, the Temperature sensor is set-up to send out signal of 30 °F at 4 mA and 90 °F at 20 mA, the low value in this case is 30 and the high value is 90.</td></tr>
</table>

	• Click “Calculate” button to calculate the slope and intercept value
	• Click “OK” to return to point window
COV Limit	10 times of slope value
Sensor Type	Current or Voltage depend on input type
Totalization Rate	None
	• From the Point menu, select “Save”
	• Repeat the same procedure to set-up internal analog inputs points for flow meter and temperature sensors

Step 2. Set-up an internal analog output (LAO) point in EMCS to store the instantaneous consumption value.

In Insight Apogee, perform the following steps:

a. Select "Point Editor". In the Point Menu select "New" then "LAO (Logical Analog Output).

b. The new point window will be displayed. Set the following parameters as specified below:

System Name	Enter a name up to 30 characters in length. For example, BLDG1.therm
Point Name	Enter a name up to 30 characters in length. For example, BLDG1.chwmmbtuph1
Field Panel	Click the button to show a list of field panels on the network, then select name of the field panel that contains the point
Descriptor	Enter up to 16 characters in length to provide some additional explanation about the application or location of the point
Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)	Check (P) box and (V) is displayed in the field. Insight will automatically assign an address to this virtual point.
Engineering Unit	MMBtu/hr
COV Limit	0.01
Initial Value	0
Totalization Rate	Hourly
	• Leave all other items at their default value and click "OK."

Step 3. Add a programming step that will use the LAI points from Step 1 to calculate for instantaneous consumption and store the LAO point value from Step 2.

In Insight Apogee, perform the following steps:

a. Select "Program Editor" Then in the Program Menu select "New".
b. In the new program window editor displayed, enter the PPCL program lines (See Appendix C). Press enter at the end of each program line.
c. From Program Menu select "Save As". The Save As dialog box will be displayed.

Set the following parameters as specified below:

System Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Field Panel	Click the button to show a list of field panels on the network, then select the name of the field panel that contains the point
	Click "OK"

Step 4. Set-up an internal analog output (LAO) point to collect monthly consumption data.

	Follow the procedure of how to set-up an internal analog output point in EMCS to store instantaneous consumption from internal EMCS calculation, except for the following parameter
Engineering Unit	MMBtu

Step 5. Add a programming step to update the point in Step 4 every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Program Editor”. Then in the Program Menu, select “New”.
b. Enter the PPCL program lines (See Appendix A) in the new program window editor. Press Enter at the end of each program line.
c. From Program Menu select “Save As”. This will display the Save As dialog box. Set the following parameters as specified below:

System Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Name	Enter a unique name up to 30 characters in length. For example, BLDG1.consumption
Field Panel	Click the button to show a list of field panels on the network, then select the name of the field panel that contains the point
	• Click “OK”

Step 6. Create Trend point extension on the internal analog output point in EMCS to record consumption values every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Trend Definition Editor”. From the Trend Menu, select “New”.
b. In the Object Selector display, select the LAO point above, and click “OK”.
c. Select “COV” in the Trend Type dialog box display, and click “OK”.
d. The Add COV Definition box will be displayed.

Set the following parameters as specified below:

Panel Samples Desired	300 samples (a panel can keep data for 3 days) or the Maximum Samples available at a panel, whichever is less
Trend COV Limit	Select “Use Trend COV Limit” with 0.01 value
PC Buffer size	1000 (PC can keep data for 10 days) or the maximum Insight Storage number, whichever is less
Enable PC Collection	Check this box to enable PC for data collection
Enable “COV Buffer Full” Notification	Check this box to enable control panel to notify Insight when the trend buffer has reached 80% full
	Click “OK” to close the Add COV Definition dialog box
	Click “OK” to the Operation Successful message

Application E. Room Temperature Monitoring

Charts E-1 through E-4 will take the user through steps to set-up a temperature sensor to monitor room temperature. Following these steps will enable the EMCS to measure room temperature (°F) and store fifteen-minute data. Chart E-1 lists the needed equipment and will help the user determine if the controller has an available input slot. Chart E-2 aids the user in choosing a temperature sensor. The chart lists each type of output from sensor accuracy for different controller models. The chart also lists wire and sensor specifications. Chart E-3 provides an example of a temperature sensor available in the market. Chart E-4 provides the EMCS programming steps. By following these steps, the user will enable the EMCS to display current temperature and record 15-minute temperature. The user should then proceed to Application F to set-up the data collection and history data storage.

Step 1. Check the input slot availability on the controller.

Use Chart E-1 to find which slots are needed on the controller. The position of the slot can be found in Chart E-1 under Controller Terminal Connections. There are three types of temperature sensor inputs acceptable in most controllers: current, voltage and thermistor. Any of these inputs can be chosen depending on the application. For example, UC has two input/output cards that have four terminal connections each. One slot is needed on UI13-UI16 on I/O card1 or UI33-UI36 on I/O card2 for a current or voltage temperature sensor. If there are no available slots, contact a Siemens representative to determine whether an expansion I/O module can be added to this controller or if an additional controller should be installed.

Step 2. Choose a Temperature Sensor.

Chart E-2 lists the temperature sensor specifications. For example, an acceptable temperature sensor for UC should have current or voltage output with ± 1.0 °F accuracy or better. The end-to-end accuracy from the temperature sensor to the UC controller could be around ± 1.5 °F. Note that to gain this accuracy the temperature sensor must be placed no

more than 750 ft. away with 14-22 AWG type wire. If this accuracy is not acceptable, a temperature sensor with better accuracy is needed or the controller must be replaced. Chart E-3 shows an example of a temperature sensor provided in the market.

Step 3. Follow the EMCS programming steps.

Chart E-4 provides the steps to set-up the external input point (from the sensor) the EMCS must recognize. Detailed steps provided in this chart must be followed to set-up the external input point.

Step 4. Follow the steps in Application F.

Application F lists the steps to set-up the data collection and history data storage.

After these steps are complete, the system can display the current temperature and record 15-minute temperature data.

Chart E-1. Room Temperature Monitoring

Verify that in addition to the sensors, the controller has the available slots as discussed below.

<table>
<tr><th></th><th>MBC</th><th>RBC</th><th>MEC</th><th>SCU</th><th>UC</th></tr>
<tr><td>What is measured</td><td colspan="5">Room temperature</td></tr>
<tr><td>What is stored in EMCS</td><td colspan="5">Fifteen-minute data of room temperature in °F stored in Trend Data History</td></tr>
<tr><td>What is needed</td><td colspan="5">1 – Temperature sensors
1 – Available slot on Terminal Block (depending on output type of each devices)</td></tr>
<tr><td>Terminal Block for Current Analog Input</td><td colspan="2">PTM6.2I420</td><td rowspan="2">AI 17 – AI 24</td><td rowspan="3">TB2-5
AI-00 to AI-15</td><td rowspan="2">I/O card1: UI13–UI16
I/O card2: UI33–UI36</td></tr>
<tr><td>Terminal Block for Voltage Analog Input</td><td colspan="2">PTM6.2U10</td></tr>
<tr><td>Terminal Block for Thermistor Analog Input</td><td colspan="2">PTM6.2N100K</td><td>N/A</td><td>N/A</td></tr>
</table>

Chart E-2. Room Temperature Monitoring

Temperature Sensor Specifications

	MBC	RBC	MEC	SCU	UC
Output Type from Temperature Sensors	Analog, current, voltage or thermistor output				
Accuracy from Temperature Sensors	The recommended accuracy for the room temperature sensor is ± 1.0 °F. Depending on the application, this accuracy may be lower.				
End-to-end Accuracy for current output*	± 1.0 °F plus the accuracy of MBC/RBC current reading		± 1.0 °F plus the accuracy of MEC current reading	± 1.0 °F plus the accuracy of SCU current reading	± 1.5 °F
End-to-end Accuracy for voltage output*	± 1.0 °F plus the accuracy of MBC/RBC voltage reading		± 1.0 °F plus the accuracy of MEC voltage reading	± 1.0 °F plus the accuracy of SCU voltage reading	± 1.5 °F
End-to-end Accuracy for thermistor output	± 1.0 °F plus the accuracy of MBC/RBC thermistor reading		N/A	± 1.0 °F plus the accuracy of SCU thermistor reading	N/A
Maximum Wire Length (ft.)	750 ft. @ 14-22 AWG				

* Temperature reading is range from 0 – 100 °F

Chart E-3. Room Temperature Monitoring

Example of Temperature Sensor Specification

Temperature Sensor		
Vaisala		
HMD 60 Y, Duct Temperature Transmitter		
Input	Temperature Range	-20 to 80 °C
Output	Standard Output	Current, 4-20 mA
	Accuracy	± 0.6 °C over the span
	Linearity	0.1 °C or better

Chart E-4. Room Temperature Monitoring

EMCS Programming Steps

Summary

1. Set-up the external analog input (LAI) points in the EMCS for the room temperature sensor.
2. Set-up an analog output (LAO) point to store the instantaneous consumption value.
3. Add a programming step to update the point value created in Step 2 every 15 minutes.
4. Create a trend point extension on the internal analog output point in the EMCS to record the room temperature every 15 minutes.

Details of these steps follow.

Step 1. Set-up the external analog input (LAI) points in the EMCS for the room temperature sensor.

In Insight Apogee, perform the following steps:

a. Connect the installed sensors to the controller
b. Select "Point Editor", then in the Point Menu select "New", then "LAI (Logical Analog Input)"
c. The new point window will be displayed.

Set the following parameters as specified below:

<table>
<tr><td>System Name</td><td colspan="4">Enter a name up to 30 characters in length. For example, BLDG1.Rm101</td></tr>
<tr><td>Point Name</td><td colspan="4">Enter a name up to 30 characters in length. For example, BLDG1.temp1</td></tr>
<tr><td>Field Panel</td><td colspan="4">Click the button to show a list of field panels on the network, then select name of the field panel that contains the point</td></tr>
<tr><td>Descriptor</td><td colspan="4">Enter up to 16 characters in length to provide some additional explanation about the application or location of the point</td></tr>
<tr><td rowspan="2">Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)</td><td colspan="4">L . DDD . PPPPP
L: FLN number, 0-3
D: Drop number, 0-099
P: Point number, 0-65,000</td></tr>
<tr><td>L is equal to 0.
D is the address key number in the PTM (Point Termination Module).
P is the actual hardware layout number.</td><td>L is equal to 0.
D is equal to 0 if point resides in MEC, or FLN number
P can be 17-24.</td><td>L is equal to 0.
D is the termination board number.
P is the termination point number.</td><td>L is FLN connecting number on field panel
D is FLN device number.
P is the termination point number.</td></tr>
<tr><td>Engineering Unit</td><td colspan="4">°F</td></tr>
<tr><td>Slope/Intercept</td><td colspan="4">Choose Slope/Intercept button to open Slope Intercept Calculator dialog box with the following parameters</td></tr>
<tr><td>Calculate Based On</td><td>MBC/RBC</td><td>MEC</td><td>SCU</td><td>UC</td></tr>
<tr><td>Sensor Type</td><td colspan="4">Current or Voltage depend on input type</td></tr>
<tr><td>Calculate Using</td><td colspan="4">English</td></tr>
<tr><td>Signal Range</td><td colspan="4">Low Value: 4 for current and 0 for voltage
High Value: 20 for current and 5 or 10 for voltage</td></tr>
</table>

Device Range	Low Value: the kW value corresponding to the low signal from sensor High Value: the kW value corresponding to the high signal from sensor For instance, Temperature sensor is set-up to send out signal of 40 °F at 4 mA and 120 °F at 20 mA. The low value in this case is 40 and the high value is 120.
	• Click “Calculate” button to calculate the slope and intercept value
	• Click “OK” to return to point window
COV Limit	0.1
Sensor Type	Current or Voltage depending on input type
Totalization Rate	None
	• From the Point menu, select “Save”
	• Repeat the same procedure to set-up internal analog inputs points for flow meter and temperature sensors

Step 2. Set-up an analog output (LAO) point to store the instantaneous consumption value.

In Insight Apogee, perform the following steps:

a. Select “Point Editor”, then in the Point Menu select “New”, then “LAO (Logical Analog Output)”

b. A new point window editor will be displayed. Set the following parameters as specified below:

System Name	Enter a name up to 30 characters in length. For example, BLDG1.Rm1
Point Name	Enter a name up to 30 characters in length. For example, BLDG1.rm1temp1
Field Panel	Click the button to show a list of field panels on the network, then select name of the field panel that contains the point
Descriptor	Enter up to 16 characters in length to provide some additional explanation about the application or location of the point
Address for current firmware revision (MBC/RBC: 2.0 or higher, SCU/UC: 12.4.2 or higher)	Check (P) box and (V) is displayed in the field. Insight will automatically assign an address to this virtual point.
Engineering Unit	°F
COV Limit	0.1
Initial Value	0
Totalization Rate	None
	Leave all other items at their default value and click “OK.”

Step 3. Add a programming step to update the point value created in Step 2 every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Program Editor”. Then in the Program Menu, select “New”.

b. In the new program window editor, enter the PPCL program lines (See Appendix A). Press enter at the end of each program line.

c. From the Program Menu, select “Save As” and the Save As dialog box will be displayed. Set the following parameters as specified below:

System Name	Enter a unique name up to 30 characters in length. For example, BLDG1.rm1temp
Name	Enter a unique name up to 30 characters in length. For example, BLDG1.rm1temp1
Field Panel	Click the button to show a list of field panels on the network, then select name of the field panel that contains the point
	Click “OK”

Step 4. Create trend point extension on the internal analog output point in EMCS to record the room temperature every 15 minutes.

In Insight Apogee, perform the following steps:

a. Select “Trend Definition Editor”. From the Trend Menu, select “New”.

b. In the Object Selector displayed, select the LAO point above and click “OK”.

c. The Trend Type dialog box will be displayed. Select “COV” and click “OK”.

d. The Add COV Definition dialog box will be displayed. Set the following parameters as specified below:

Panel Samples Desired	300 samples (Panel can keep data for 3 days) or the Maximum Samples available at Panel, whichever is less
Trend COV Limit	Select “Use Trend COV Limit” with 0.01 value
PC Buffer size	1000 (PC can keep data for 10 day) or the maximum Insight Storage number, whichever is less
Enable PC Collection	Check this box to enable PC for data collection
Enable “COV Buffer Full” Notification	Check this box to enable control panel to notify Insight when the trend buffer has reached 80% full
	• Click “OK” to close the Add COV Definition dialog box
	• Click “OK” to the Operation Successful message

Application F. Data Collection Configuration and Storage in Insight and Data Collection and Archiving in Infocenter

There are three parts in the data collection process. First, the Trend Definition collects data in the controller memory and directs it to the PC Insight Workstation. A limited amount of data will be saved in the Workstation as specified in the Trend Definition. When the amount of data reaches that limit, the new data will overwrite the old data. The second part of the data collection process involves storing historical data to avoid data loss. This is achieved by setting up Trend Sample Report and scheduling Trend Collection and Report Collection. The generated reports contain the history data and will be saved under a specific directory that is recognized by Infocenter. Import Definition and Archive Schedule will then be set-up. The Import Definition will transfer the point data file from PC workstation to the InfoCenter Server. Here the point data records can be retained indefinitely or for a specified time interval after which they can be archived to disk-based media for long-term storage. The Archive Schedule is set-up to move data periodically and automatically to off-line storage. Archived data can still be viewed and exported along with the most current data.

Step 1. Set-up a Trend Sample Report.

Follow the steps below to set-up a Trend Sample Report. This will create a report that displays all values collected for the selected points.

In Report Builder, perform the following steps:

a. From the Definition menu, select “New”.
b. From the list, select “Trend Sample Report”.
c. Click “OK”.
d. Under Trend Points, click “Configure”.
e. Click “Add” to add trend points and the object selector window will be displayed.
f. Click “Find Now” and select the points to be trended. When complete, click “OK”.
g. Click “OK” on the object selector window.
h. Under Output, click “Configure”.

i. Check “File” box in the Report Output Options dialog box. Enter a file name and path this report will be saved to.

Step 2. Schedule a Trend Collection.

Follow the steps below to schedule a Trend Collection. This will upload the trend data of the specified points in the trend collection report definition from the field panel to the Insight PC.

In Scheduler, perform the following steps:

a. From the daily tab, select a starting day.
b. From the schedule menu, select “New” then “Trend Collection”. The object selector will be displayed.
c. Click “Find Now” and select the trend collection report to be displayed. Then click “OK”.
d. The Add Trend Collection Schedule dialog box will be displayed.
e. Enter the starting date of the trend collection time in Schedule Date.
f. Enter the starting time of trend collection in Collection Time.
g. Check the “Enabled” box to allow the trend collection.
h. Under Repetition, choose frequency to be “Daily” and select “Continuous”. Then click “OK”.

Step 3. Schedule a Report Collection.

Follow the steps below to schedule a Report Collection to create a report. This report will contain the data stored at the defined output destination for the scheduled date and time. This report will be a part of the database in Infocenter.

In Scheduler, perform the following steps:

a. From the daily tab, select a starting day.
b. From the schedule menu, select “New” then “Report”. The object selector will be displayed.
c. Click “Find Now” and select the report to be scheduled. Then click “OK”.
d. The Add Report dialog box displays.
e. Enter the starting date of the report time in Scheduled Date.
f. Enter the starting time of report in Execution Time.

g. Check the “Enabled” box to allow the report schedule.
h. Under Repetition, choose frequency to be “Daily” and select “Advanced Button”.
i. Check “Delimited Text”, “Overwrite File”, then click “OK”.

Step 4. Set-up Import Definition.

Follow the steps below to set-up an Import Definition to import data from Insight Workstation into InfoCenter Server.

In the InfoCenter Administrator Import Definition view, perform the following steps:

a. Click “New”. The New Import dialog box appears.
b. Enter an import definition name in the Import Name field.
c. Enter any comments regarding the import definition in the Description field.
d. Click “Automatically” to allow the InfoCenter Server to collect data whenever a new data file is written to the import directory.
e. Select “CSV” as the format of the import data.
f. Type the path and file name of the data file to be imported in the From File field.
g. To assign InfoCenter Server point attributes to a point, select the point or cell and click “Properties”.
h. Click “OK”.

Step 5. Set-up Archive Schedule.

Follow the steps below to set-up an Archive Schedule to move point data record from the active server to an off-line disk-based storage.

In the InfoCenter Administrator Archive Schedules view, perform the following steps:

a. Click “New”. The New Archive Schedule dialog box appears.
b. Enter an archive schedule name in the Schedule Name field.
c. Enter any comments regarding the new archive schedule in the Description field.
d. Check “Enabled” box to automatically move the data records.
e. Select the intermediary volume where the data records will be archived from the Archive Point Data Records to Intermediary Volume list.
f. Select “Weekly” Frequency and On “Sunday”.
g. Under Retention Period, click the “Months” option and enter “12” in the space to retain the data record for 12 months in the Active Volume.

h. Under Points, click “Add Points” and select points whose data records are to be archived from the Select Point dialog box.
i. Click “OK”.

APPENDICES

Appendix A: Data Logging Program

Insight offers a data logging feature for each point in the controller. There are two methods Trend Definition can use to record data. One method is to set the point in Trend Definition to record data at specific time intervals (such as at the top of the hour or quarters of the hour). The other method is to set the point in Trend Definition to record the data when the value of the point changes by a specified amount. For electrical monitoring, it is preferred to record data at a specified time interval (every 15 minutes) at the top of every hour. Once the point recognizes the Trend Definition, it is guaranteed the data will be recorded every 15 minutes. However, this does not necessarily occur at the top of the hour. One of several solutions is the following program. This program will store the monitoring value to another parameter every 15 minutes starting at the top of the hour. Using the change of value method to store data, the Trend Definition will be assigned to the new parameter. We will get trend history of the monitored value every 15 minutes starting at the top of the hour.

Assume we would like to have electrical consumption trended every 15 minutes starting at the top of the hour. We would use the following parameters in the program:

- *Bldg1.kw* is the electrical demand reading in kW unit from the Watt Transducer.
- *Bldg1.kwhr15* is the electrical consumption in kWh unit recorded with 15 minute intervals starting at the top of the hour.
- *Bldg1.nexttime* is the Next Time recording the data.
- *Bldg1.const* is the Constant time increment value, 0.25 (15 minutes in decimal unit).
- *UCM.Bldg1.kwhr* is the electrical consumption parameter in kWh unit, which will be used in Utility Cost Manager to calculate for the billing in each month.

```
00001  C Beginning of the Program
00005  C Line 10 is to reset the BLDG1.NEXTTIME parameter to 0.0 within 1 minute 48 seconds after midnight of each day
00010  IF(CRTIME .GE. 0.0 .AND. CRTIME .LE. 0.03 .AND. "BLDG1.NEXTTIME" .GE. 24.0) THEN "BLDG1.NEXTTIME" = 0.0
00015  C If Current Time is Less Than BLDG1.NEXTTIME value, go to line 90 and no 15-minutes electrical consumption is updated
00020  IF(CRTIME .LT. "BLDG1.NEXTTIME") THEN GOTO 90
00025  C Line 30 is to set the next time that 15-minutes electrical consumption will be updated
00030  "BLDG1.NEXTTIME" = "BLDG1.NEXTTIME" + "BLDG1.CONST"
00035  C BLDG1.KWHR15 is the accumulation of electrical demand BLDG1.KW updated every 15 minutes
00040  "BLDG1.KWHR15" = TOTAL("BLDG1.KW")
00045  C Line 50 is to prevent the possibility of having decrement consumption value
00050  IF("BLDG1.KWHR15" .GE. "UCM.BLDG1.kwhr") THEN "UCM.BLDG1.kwhr" = "BLDG1.KWHR15" ELSE "UCM.BLDG1.kwhr" =
       "UCM.BLDG1.kwhr"
00055  C At the end of each month, BLDG1.KWHR and UCM.BLDG1.kwhr will be reset to 0 within 1 minute and 12 seconds before
       midnight
00060  IF(MONTH .EQ. 1 .OR. MONTH .EQ. 3 .OR. MONTH .EQ. 5 .OR. MONTH .EQ. 7 .OR. MONTH .EQ. 8 .OR. MONTH .EQ. 10 .OR. MONTH
       .EQ. 12) THEN GOTO 90
00070  IF(MONTH .EQ. 4 .OR. MONTH .EQ. 6 .OR. MONTH .EQ. 9 .OR. MONTH .EQ. 11) THEN GOTO 110
00080  IF(MONTH .EQ. 2) THEN GOTO 130
00090  IF(DAYOFM .EQ. 31 .AND. CRTIME .GT. 23.98) THEN INITTO(0.0,"BLDG1.KWHR","UCM.BLDG1.kwhr")
00100  GOTO 10
00110  IF(DAYOFM .EQ. 30 .AND. CRTIME .GT. 23.98) THEN INITTO(0.0,"BLDG1.KWHR","UCM.BLDG1.kwhr")
00120  GOTO 10
00130  IF(DAYOFM .EQ. 28 .AND. CRTIME .GT. 23.98) THEN INITTO(0.0,"BLDG1.KWHR","UCM.BLDG1.kwhr")
00140  GOTO 10
```

Appendix B: Thermal Consumption Accuracy

The accuracy of thermal consumption depends on the temperature sensor accuracy, the flow meter accuracy and the temperature difference as shown in the following tables. Each table represents the thermal consumption calculation accuracy based on a specific temperature difference and combinations of temperature sensor accuracy and flow meter accuracy. For example, if a chilled water system has a temperature difference between the supply and return at 8°F and we would like to control the thermal consumption accuracy to be below 10%, we can select several combinations of temperature sensors and flow meter from the accuracy shown in Table B.2. We can choose a temperature sensor at 0.2 or at 0.5°F accuracy with a flow meter of 0.5, 1 or 2% accuracy. For instance, a combination of temperature sensors with 0.5 °F accuracy, a flow meter with 2% accuracy, and an 8°F temperature difference, yield a thermal consumption calculation accuracy of 8.38%. A better accuracy can be achieved with a more accurate temperature sensor, a more accurate flow meter, or a higher difference in temperature. The thermal consumption accuracy of the above example can be improved from 8.38% to 4.55% using a temperature sensor with 0.2°F accuracy. Note that the above accuracy has not included the accuracy from the controller reading, signal loss along the wire, etc. The accuracy only takes the temperature sensor and flow meter into account.

Table B.1 Thermal Consumption Calculation Accuracy Based on 5°F Temperature Difference

Flow meter accuracy (%)	Temperature sensor accuracy (°F)			
	0.2	0.5	1.0	2.0
0.5	4.52 %	10.55 %	20.60 %	40.70 %
1	5.04 %	11.10 %	21.20 %	41.40 %
2	6.08 %	12.20 %	22.40 %	42.80 %

Table B.2 Thermal Consumption Calculation Accuracy Based on 8 °F Temperature Difference

Flow meter accuracy (%)	Temperature sensor accuracy (°F)			
	0.2	0.5	1.0	2.0
0.5	3.01 %	6.78 %	13.06 %	25.63 %
1	3.53 %	7.31 %	13.63 %	26.25 %
2	4.55 %	8.38 %	14.75 %	27.5 %

Table B.3 Thermal Consumption Calculation Accuracy Based on 10 °F Temperature Difference

Flow meter accuracy (%)	Temperature sensor accuracy (°F)			
	0.2	0.5	1.0	2.0
0.5	2.51 %	5.53 %	10.55 %	20.60 %
1	3.02 %	6.05 %	11.10 %	21.20 %
2	4.04 %	7.10 %	12.20 %	22.40 %

Table B.4 Thermal Consumption Calculation Accuracy Based on 12 °F Temperature Difference

Flow meter accuracy (%)	Temperature sensor accuracy (°F)			
	0.2	0.5	1.0	2.0
0.5	2.18 %	4.69 %	8.88 %	17.25 %
1	2.68 %	5.21 %	9.42 %	17.83 %
2	3.70 %	6.25 %	10.50 %	19.00 %

Appendix C: Thermal Consumption Calculation Program

Supply and return water temperature and their flow rates are obtained for thermal consumption calculation. The following formula is used to determine a thermal energy usage applicable to chilled water and hot water systems.

- *Bldg1.cwrt* is the measured Chilled Water Return Temperature in °F.
- *Bldg1.cwst* is the measured Chilled Water Supply Temperature in °F.
- *Bldg1.cwflo* is the measured Chilled Water Flow rate in GPM.
- *Bldg1.cwdt* is the calculated Chilled Water Differential Temperature.
- *Bldg1.chwgpm* is the Chilled Water flow rate in GPM.
- *Bldg1.cwrtc* is the calculated Chilled Water Return Temperature in °C.
- *Bldg1.T2* is chilled water return Temperature in °C power of 2.
- *Bldg1.T3* is chilled water return Temperature in °C power of 3.
- *Bldg1.T4* is chilled water return Temperature in °C power of 4.
- *Bldg1.T5* is chilled water return Temperature in °C power of 5.
- *Bldg1.chwdensity* is the calculated Chilled Water Density.
- *Bldg1.cmmbtu* is the calculated Chilled water consumption in MMBtu.
- $LOC1 and $LOC2 are temporary intermediate variables.

```
00010  "BLDG1.CWDT" = "BLDG1.CWRT" - "BLDG1.CWST"
00015  C If BLDG1.CWDT is negative, set this differential temperature parameter to zero to prevent the negative value in
       consumption calculation
00020  IF("BLDG1.CWDT" .LE. 0.0) THEN SET(0.0,"BLDG1.CWDT")
00030  "BLDG1.CHWGPM" = "BLDG1.CWFLO"
00035  C If BLDG1.CHWGPM is negative, set this flow rate parameter to zero to prevent the negative value in consumption
       calculation
00040  IF("BLDG1.CHWGPM" .LE. 0.0) THEN SET(0.0,"BLDG1.CHWGPM")
00050  "BLDG1.CWRTC" = ("BLDG1.CWRT" - 32) * 5 / 9
00060  "BLDG1.T2" = "BLDG1.CWRTC" * "BLDG1.CWRTC"
00070  "BLDG1.T3" = "BLDG1.CWRTC" * "BLDG1.CWRTC" * "BLDG1.CWRTC"
00080  "BLDG1.T4" = "BLDG1.CWRTC" * "BLDG1.CWRTC" * "BLDG1.CWRTC" * "BLDG1.CWRTC"
00090  "BLDG1.T5" = "BLDG1.CWRTC" * "BLDG1.CWRTC" * "BLDG1.CWRTC" * "BLDG1.CWRTC" * "BLDG1.CWRTC"
00095  C Chilled water Density Calculation.  Note that the chilled water density calculation can be omitted with a less
       than 0.5% sacrifice in accuracy when using a constant, which is calculated based on the average return
       temperature
00100  "BLDG1.CHWDENSITY" = (999.8395 + 0.06798 * "BLDG1.CWRTC" - 0.00911 * "BLDG1.T2" + 0.0001 * "BLDG1.T3" - 1.127e-06
       * "BLDG1.T4" + 6.592e-09 * "BLDG1.T5") / 16.01846
00105  C Thermal Consumption Calculation
00110  $LOC1 = "BLDG1.CHWGPM" * "BLDG1.CWDT" * "BLDG1.CHWDENSITY"
00120  $LOC2 = $LOC1 * 1.0005 * 60 / 7.4805
00130  "BLDG1.CMMBTU" = $LOC2 / 1000 / 1000
00140  GOTO 10
```

Note: Chilled water density in this program is calculated based on chilled water return temperature and the assumption that the flow meter is installed on the chilled water return pipe. If the flow meter in your building is installed on the chilled water supply pipe, substitute "BLDG1.CWRT" with "BLDG1.CWST" on line 00050.